Technical Report 1370

Tier One Performance Screen (TOPS) Initial Operational Test and Evaluation (IOT&E): An Examination of Attrition Over Time

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14. ABSTRACT *(Maximum 200 words)*:

This research was carried out as part of the Tier One Performance Screen (TOPS) initial operational test and evaluation (IOT&E) conducted by the U.S. Army Research Institute (ARI). It focuses on examining Soldier attrition as it occurs over time and provides a targeted evaluation of the Tailored Adaptive Personality Assessment System (TAPAS) as it relates to attrition outcomes. In addition to examining overall attrition, three broad categories of attrition were examined: Performance-, Misconduct-, and Medical/Physical-related attrition. Results revealed attrition to occur most frequently within the first 6 to 12 months of Soldiers' tenure in the Army, with Performance- and Medical/Physical-related attrition demonstrating the highest rates within the first 12 months. Rates of Misconduct-related were low initially but increased steadily until approximately 18 months. Results also showed differences between types of attrition with respect to the TAPAS scale relationships. The Physical Conditioning TAPAS scale had a strong negative association with Performance- and Medical/Physical-related attrition as well as overall attrition. Physical Conditioning was often a stronger predictor of these attrition types than the Armed Forces Qualification Test (AFQT). Of all the TAPAS scales, Non-Delinquency generally had the strongest association with Misconduct-related attrition. In general, the AFQT exhibited a consistently strong, negative relationship with overall attrition and all three types.

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TIER ONE PERFORMANCE SCREEN INITIAL OPERATIONAL TEST AND EVALUATION (IOT&E): AN EXAMINATION OF ATTRITION OVER TIME

EXECUTIVE SUMMARY

Research Requirement:

This paper describes research conducted as part of the Tier One Performance Screen (TOPS) initial operational test and evaluation (IOT&E). Specifically, this research focuses on examining Soldier attrition as it occurs over time. Additionally, this research provides a targeted evaluation of the Tailored Adaptive Personality Assessment System (TAPAS) as it relates to attrition outcomes.

Procedure:

Data for this research were from the 2014 TOPS IOT&E annual report database. To guide this investigation, analyses were aimed at addressing three broad research questions related to understanding (a) attrition rates over time, (b) predictors of attrition over time, and (c) predictors of attrition at critical time points during Soldiers' tenures. In addition to examining overall attrition, discrete categories of attrition were identified using inter-service separation code (ISC) data. In total, three broad categories of attrition were examined: Performance-, Misconduct-, and Medical/Physical-related attrition.

Given the longitudinal focus of this research, we examined base rates of attrition at 3-month intervals, starting with 3 months post-accession into the Army through 48 months post-accession. Descriptive frequency statistics are provided to describe base rates of Soldier attrition over time. With respect to predicting attrition over time, Cox proportional hazards regression was used to identify TAPAS scales that exhibit significant relationships with attrition. Finally, logistic regression analyses were used to examine the TAPAS scale predictors of attrition for Soldiers in their first 6 months of tenure, after 6 months through 12 months, after 12 months through 24 months, and after 24 months through 36 months. The effect of the AFQT on attrition also was evaluated in the Cox proportional hazards and logistic regression analyses.

Findings:

Results of the descriptive analyses revealed attrition to occur most frequently within the first 6 to 12 months of Soldiers' tenure in the Army, although the base rate of overall attrition for each 3-month interval is low across the first 48 months ($\leq 7.2\%$). The highest rates of Performance- and Medical/Physical-related attrition occur early in Soldiers' terms, and account for over 50% of all attrition within the first 12 months of tenure. Conversely, Misconduct-related attrition accounts for less than 10% of all attrition within the first 12 months of service. However, its rate of occurrence increases sharply until approximately 18 months, from which time it accounts for over 50% of all attrition through 45 months of service.

Results of the Cox proportional hazards and logistic regression analyses revealed differences between types of attrition with respect to the TAPAS scale relationships. In general, the Physical Conditioning TAPAS scale had a strong negative association with Performance- and Medical/Physical-related attrition as well as overall attrition. Moreover, the Physical Conditioning TAPAS scale was often a stronger predictor of these attrition types than the AFQT. Of all the TAPAS scales, Non-Delinquency generally had the strongest association with Misconduct-related attrition. In general, the AFQT exhibited a consistently strong, negative relationship with overall attrition and all three types.

Utilization and Dissemination of Findings:

The research findings will be used by the Army Deputy Chief of Staff, G-1; U.S. Army Recruiting Command; Assistant Secretary of the Army (Manpower and Reserve Affairs); and Training and Doctrine Command to evaluate the effectiveness of tools used for Army applicant selection and assignment.

**TIER ONE PERFORMANCE SCREEN (TOPS)
INITIAL OPERATIONAL TEST AND EVALUATION (IOT&E): AN EXAMINATION
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TIER ONE PERFORMANCE SCREEN (TOPS)
INITIAL OPERATIONAL TEST AND EVALUATION (IOT&E): AN EXAMINATION OF ATTRITION OVER TIME

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In addition to educational, physical, and moral screens, the U.S. Army relies on the Armed Forces Qualification Test (AFQT), a composite score from the Armed Services Vocational Aptitude Battery (ASVAB), to select new Soldiers into the Army. Although the AFQT continues to serve as a useful metric for selecting new Soldiers, there is a growing recognition of the need to consider whole-person assessment, which takes other personal attributes (in particular, non-cognitive attributes such as temperament, interests, and values) into consideration. Based on previous research (Knapp & Heffner, 2010), the Army selected one particularly promising measure, the Tailored Adaptive Personality Assessment System (TAPAS), as the basis for an initial operational test and evaluation (IOT&E) of the Tier One Performance Screen (TOPS). To date, there have been 11 evaluations of the TAPAS administered in TOPS, the most recent being in 2014 (e.g., Knapp & LaPort, 2014).

Research to date suggests that several TAPAS scales relate significantly to a number of important criteria. The current effort extends the biannual evaluations conducted as part of the TOPS IOT&E by focusing on the predictive capabilities of the TAPAS with regard to one particularly important outcome: Soldier attrition. Data from the 10th cycle of the TOPS IOT&E longitudinal data collection effort were used to construct predictive models of Soldier attrition to determine which attributes measured as part of the preenlistment screening process might constitute "best bet" predictors of attrition.

To extend prior research on Soldier attrition (e.g., McHenry, Hough, Toquam, Hanson, & Ashworth, 1990; Putka & Bradley, 2008; Strickland, 2005; White, Rumsey, Mullins, Nye, & LaPort, 2014) as well as expand upon prior TAPAS research that has investigated attrition specifically, we examined specific types, or causes, of attrition (namely, performance, misconduct, and medical/physical attrition) in addition to overall attrition (i.e., separation from the Army regardless of reason). Models relevant to overall attrition are useful for examining which attributes predict attrition from a general "bottom-line" perspective, whereas models focusing on attrition due to particular reasons add nuance by indicating which attributes predict different types of attrition, each of which is associated with different origins.

To guide this research, we sought to address three interrelated, overarching questions:

(1) *How does Soldier attrition change over time?* How does the probability of separating from the Army change as a Soldier progresses through his or her first term of service? What is the pattern of change over time for overall attrition? Are different patterns of change observed for different types of attrition?

(2) *Which attributes predict attrition across Soldiers' first-term tenure within the Army?* Which cognitive and noncognitive attributes predict the probability with which Soldiers separate over time, taking into account the full information available across

all time points under observation? Which attributes are relevant for predicting overall attrition, as well as the various types of attrition under study? Is there evidence that relationships between Soldier attributes and attrition vary across time, indicating that the relevance of a predictor increases or decreases at different points during a Soldier's tenure?

(3)   *Which attributes predict attrition at critical junctures in Soldier tenure?* Which of the cognitive and noncognitive attributes predict the probability with which Soldiers attrit at distinct, key periods of time? At each time period, which attributes are relevant for predicting overall attrition, as well as the various types of attrition under study?

Data relevant to the first question (i.e., percentage of Soldiers separating at each time point, both overall and by separation category) provide context concerning the prevalence of Soldier attrition. With regard to the separation categories, the first question also addresses descriptive information regarding which types of attrition are most prevalent in general and whether different patterns of temporal change are observed across types of attrition. Evidence of differential patterns of change over time and across separation categories can be used to link the categories to relevant events or phases that occur in a Soldier's career (e.g., transition from Soldier training to placement within an assigned unit). Further, previous research has shown differential rates of attrition across time for different types of attrition (Strickland, 2005).

The second and third questions pertain to cognitive and noncognitive attributes that could be used to predict Soldier attrition. Analyses associated with the second question will employ an extension of the Cox proportional hazards regression model to examine attributes that can be used to predict attrition across Soldiers' first-term enlistment period, up through 4 years of service. Analyses pertaining to the third question will employ logistic regression models to examine attrition at discrete time points of particular interest within a Soldier's first-term enlistment period (namely, 6, 12, 24, and 36 months).

At the outset of this investigation, we anticipated that different sets of attributes might predict different types of attrition. Strickland (2005) found that relationships between attrition and Soldiers' personal characteristics, attitudes, and beliefs about the Army varied across different attrition types. With regard to attrition due to performance reasons, attributes relevant to core task performance such as cognitive ability and conscientiousness (Motowidlo, Borman, & Schmit, 1997) as well as physical conditioning (Strickland, 2005) are likely to be related to this type of attrition, which stems from an inability to meet Army performance standards. Attrition due to misconduct, which is comparable in nature to constructs such as counterproductive work behaviors (CPWBs; Gruys & Sackett, 2003) and deviance (Robinson & Bennett, 1995), should be predicted by attributes that have been linked to these constructs (e.g., integrity, achievement, emotional stability; Cullen & Sackett, 2003). Finally, attrition due to medical and physical reasons should be linked to attributes relevant to maintaining one's physical condition (e.g., McHenry et al., 1990; Strickland, 2005) as well as workplace safety (e.g., conscientiousness, locus of control, impulsiveness; Beus, Dhanani, & McCord, 2015).

Analytic Approach

Analyses were conducted on the TOPS IOT&E data file used for the 2014 annual report (Knapp & Wolters, 2015), which includes data on Soldiers from multiple military occupational specialties (MOS). For the purposes of this investigation, we included only Regular Army Soldiers with Tier 1 educational credentials.[1] Given our focus on attrition, we excluded from analyses Soldiers who had missing attrition or inter-service separation code (ISC) data, or conflicting attrition and ISC records (e.g., indicated as not separating but had an ISC). We also excluded data from Interpreters and Translators (09L and 09C) because the TAPAS is not used in preenlistment screening for these occupations. For all predictive analyses, we applied additional filters to reflect the sample used in the broader TOPS IOT&E validation analyses. Specifically, Soldiers included in the predictive analyses were limited to those with valid TAPAS and criterion data, as well as those who did not take TAPAS version 13D. Table 1 presents descriptive statistics concerning the samples used in the present research.

Table 1. Sample Characteristics

Characteristic	Descriptive *n* = 168,321		Predictive *n* = 156,558	
	n	*%*	*n*	*%*
Gender				
Female	25,074	14.9	23,626	15.1
Male	136,823	81.3	127,045	81.2
Missing	6,424	3.8	5,887	3.8
Race				
African American	36,852	21.9	34,177	21.8
American Indian	1,181	0.7	1,117	0.7
Asian	7,281	4.3	6,727	4.3
Hawaiian/Pacific Islander	690	0.4	622	0.4
Caucasian	118,785	70.6	110,655	70.7
Multiple	703	0.4	634	0.4
Missing/Declined to Answer	2,829	1.7	2,626	1.7
Ethnicity				
Hispanic/Latino	25,711	15.3	23,821	15.2
Not Hispanic	140,139	83.3	130,454	83.3
Missing/Declined to Answer	2,471	1.5	2,283	1.5

Note. Both the Descriptive and Predictive samples were limited to Regular Army Soldiers with Tier 1 educational credentials and valid attrition and inter-service separation code data. Soldiers whose MOS were 09L or 09C were excluded from all analyses. The Predictive sample was limited further to include Soldiers with valid TAPAS and criterion data, and exclude Soldiers who took TAPAS version 13D.

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[1] Tier 1 educational credentials include individuals with a high school diploma or its equivalent or higher (e.g., college degree, adult/alternative diploma, home school diploma). In 2012, the Department of Defense announced that applicants who score 50 or higher on the AFQT and possess diplomas from home schools, virtual/distance learning, and adult/alternative schools would receive Tier 1 enlistment priority.

We categorized the type of attrition using ISC records. Note that attrition records for some Soldiers indicated separation due to family or dependent reasons, or otherwise unspecified reasons. Given the low incidence or otherwise ambiguous nature of these attrition types, we did not include them as focal categories for analysis. However, Soldiers from these categories were included in our analyses of overall attrition as well as treated as non-focal attrition cases (i.e., competing risks) during our analyses of Performance-, Misconduct-, and Medical/Physical-related attrition categories. Table 2 provides the ISCs associated with each focal separation category.

Table 2. Focal Separation Categories by Inter-service Separation Codes

Separation Category	Inter-service Separation Codes
Performance	86: Unsatisfactory Performance
	87: Entry Level Performance and Conduct
Misconduct	64: Alcohol Rehabilitation Failure
	65: Pattern of Misconduct
	67: Misconduct (Drug Abuse); Drug Rehabilitation Failure
	71: Misconduct (Civil Conviction)
	73: Court-Martial; Court-Martial, Desertion
	75: Misconduct (AWOL); Misconduct (Desertion); Dropped From Rolls-As Deserter
	77: Misconduct (Sexual Perversion)
	78: In Lieu of Trial by Court-Martial
	80: Unacceptable Conduct (Vol Sep ILO Elimination); Disability, Not in Line of Duty; Misconduct (Other); Unacceptable Conduct
	83: Misconduct (Minor Infractions)
	84: Misconduct (Serious Offense)
Medical/Physical	10: Disability, Existed Prior to Service, Physical Evaluation Board (PEB); Disability, Aggravation
	14: Disability, Other
	16: Failed Medical/Physical Procurement Standards; Physical Standards; Condition, Not a Disability; Failure to Meet Procurement Medical Fitness Standards
	17: Weight Control Failure; Condition, Not a Disability; Physical Standards

For all analyses, a common set of 15 core TAPAS scales were included. For the regression analyses conducted to address the second and third research questions, all 15 scales were initially tested within a single model before eliminating nonsignificant predictors. Data for an additional six TAPAS scales were not available for all Soldiers in the present sample and thus were excluded from analyses. Appendix A provides the list of TAPAS scales used in the present analyses.

Question 1: How does Soldier attrition change over time?

To answer this question, we conducted descriptive analyses of Soldier overall attrition and of attrition by separation category. Given the longitudinal focus of this research, we examined base rates of attrition at 3-month intervals, starting with 3 months post-accession into the Army

through 48 months post-accession. We also computed correlations between attrition over time and both the AFQT and TAPAS scales. Note that for each time point, Soldiers were counted as separating from the Army if they separated at any time following the previous time point up to and including the specified time point. For example, Soldiers who separated between 1 day and 3 months post-accession all were counted as cases of 3-month attrition, whereas Soldiers who separated between 3 months plus 1 day and 6 months all were counted as cases of 6-month attrition.

Question 2: What attributes predict attrition across Soldiers' first-term tenure within the Army?

This question was aimed at examining relations between the AFQT and TAPAS scales with attrition over time. Specifically, we used Cox proportional hazards regression to examine the nature of predictive relationships with attrition when accounting for the amount of time to attrition through 48 months post-accession. Cox proportional hazards regression is a class of survival models used to examine relationships between a set of predictors and time to event occurrence (e.g., time to attrition; Klein & Moeschberger, 2003). When multiple types of events are possible (i.e., different reasons for attrition), alternative events correspond to "competing risks" in that the occurrence of one type of event precludes the occurrence of another. In the case of separation categories, we used cause-specific (or event-specific) hazard modeling (Singer & Willett, 2003, p. 592) to study the predictors of each individual type of attrition. In these models, Soldiers who separated due to the focal separation category were coded as experiencing the event (i.e., separating from the Army), and those who either stayed or separated due to alternative reasons were treated as censored. In addition, we conducted Cox proportional hazards regression for overall attrition, in which all Soldiers who separated from the Army were coded as separating. For all proportional hazards regression analyses, Soldiers who separated at a given time point were removed from the risk set (i.e., treated as missing data) at all subsequent points in time.

In fitting the proportional hazards regression models for both overall attrition and by separation category, we started by modeling the main effects of the AFQT and all 15 core TAPAS scales. Next, we removed nonsignificant predictors ($p \geq .05$) and then fit a reduced model to reexamine the effects. We continued fitting models in this manner until only significant main effects remained in the model. At this point, we used regression diagnostics to test for potential time-varying effects (i.e., predictor relationships with attrition that change over time). In particular, we examined correlations between Schoenfeld residuals and time (Schoenfeld, 1982).[2] Because main effects in a proportional hazards regression model are assumed to be constant (i.e., proportional) over time (Singer & Willett, 2003), residuals that correlate with time may indicate a violation of this assumption (Harrell, 2010). To formally test for time-varying effects, we next fit another proportional hazards regression model with both significant main effects and predictor interactions with time (modeled as a linear trend) for those predictors with significant Schoenfeld correlations.[3]

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[2] Schoenfeld residuals are calculated for each predictor as the difference between the observed and expected predictor values. Schoenfeld residuals are calculated for attriters only and are undefined for censored individuals (i.e., stayers).
[3] We used a linear trend for time in all proportional hazards regression analyses. As such, any significant time-varying effects reflect effects that follow a linear trend. Although it is possible to test various other forms of time (e.g., log time), we have no a priori theory to suggest that the effects of the AFQT or TAPAS scales vary in a non-linear fashion.

We discuss the results of the final Cox proportional hazards regression models comprising significant main and time-varying effects. Specifically, we report standardized regression coefficients, hazard ratios (*HR*s), and the associated confidence intervals (CIs) for the *HR*s. A *HR* (or relative risk) reflects the risk of a given event's (e.g., attrition) occurrence that is attributable to a unit change in a predictor (e.g., AFQT). In the present research, the AFQT and TAPAS scale predictor scores are expressed as *z*-scores on a $N(0,1)$ distribution. Thus, *HR*s represent the amount of change in the hazard of attrition associated with each standard deviation change in the predictor. Note that *HR*s less than 1.0 reflect negative relationships (i.e., decreasing occurrence of attrition with increasing values of the predictor), *HR*s greater than 1.0 reflect positive relationships, and *HR*s equal to 1.0 reflect no relationship between a given predictor and outcome. Values farther away from 1.0 reflect stronger relationships, although *HR*s cannot fall below 0.0. Additionally, we computed 95% CIs for the *HR*s, which can be interpreted as indices of both precision and statistical significance for each. That is, CIs that contain 1.0 indicate non-significant relationships between a given predictor and attrition, and effects associated with narrower CIs are more precisely estimated than are effects with wider CIs. Finally, we provide plots showing the model-estimated *HR*s for predictors with a significant interaction with time to aid in the interpretation of time-varying effects.

Question 3: What attributes predict attrition at critical junctures in Soldier tenure?

We used logistic regression analyses to address our third research question. In particular, we examined attrition by separation category at four discrete time periods post-accession: (a) 1 day through 6 months, (b) after 6 months through 12 months, (c) after 12 months through 24 months, and (d) after 24 months through 36 months. We began by fitting models with the AFQT and all core TAPAS scales for each separation category and time period. We then removed the nonsignificant ($p \geq .05$) effects before fitting a reduced model. We continued fitting models in this manner until only significant predictors remained. Results of the logistic regression analyses are presented for the final reduced models for each separation category and time period. Specifically, we computed odds ratios (*OR*s) and corresponding confidence intervals (CIs) for each predictor in the final model.

Odds ratios can be used to assess the amount of change in the probability (or odds) of a given outcome depending on change in a predictor. Specifically, for each one-unit change in the predictor value, the odds of the outcome are multiplied by the value of the *OR* (Cohen, Cohen, West, & Aiken, 2003). Like *HR*s, *OR*s less than 1.0 indicate a negative predictor relationship with attrition, *OR*s equal to 1.0 reflect no relationship, and *OR*s greater than 1.0 indicate a positive relationship. Similarly, *OR*s farther from 1.0 reflect stronger relationships, and values cannot fall below 0.0. Additionally, 95% CIs for the *OR*s that contain 1.0 indicate non-significant relationships between a given predictor and outcome.

Results

Question 1: How does Soldier attrition change over time?

Base rates for overall attrition and the separation categories of Performance-, Misconduct-, and Medical/Physical-related attrition are presented in 3-month intervals in Table 3. Cumulative attrition rates over time are presented in Table 4. Although we also conducted correlational

analyses, we do not present those results because relationships between the AFQT and TAPAS scales are discussed with respect to the Cox proportional hazards and logistic regression analyses. For overall attrition and attrition due to performance and medical/physical reasons, Table 3 shows that the incidence (n) and rate (%) of attrition is highest at 3 months (Overall: n = 12,101, 7.2%; Performance: n = 5,508, 3.3%; Medical/Physical: n = 6,555, 3.9%). Comparatively, the highest attrition rate (1.0%) for Misconduct-related attrition occurs later and peaks at months 21, 24, 27, 36, and 42. However, the incidence of Misconduct-related attrition is highest at 18 months (n = 857). Note that the total number of Soldiers in the sample decreases with each time point due to attrition and other censoring over time. Thus, the time points with the highest base rates of attrition may not be the same as those with the greatest incidence of attrition.

Table 3. Base Rates of Attrition by Time Period

Month	Stayers		Attrition									
			Overall		Performance		Misconduct		Medical/Physical		All Other Attrition	
	n	%	n	%	n	%	n	%	n	%	n	%
3	156,220	92.8	12,101	7.2	5,508	3.3	20	0.0	6,555	3.9	18	0.0
6	142,363	96.2	5,630	3.8	3,271	2.2	214	0.1	2,095	1.4	50	0.0
9	130,664	98.4	2,147	1.6	693	0.5	402	0.3	968	0.7	84	0.1
12	121,217	98.6	1,732	1.4	282	0.2	642	0.5	700	0.6	108	0.1
15	107,806	98.5	1,625	1.5	143	0.1	788	0.7	524	0.5	170	0.2
18	96,723	98.4	1,554	1.6	105	0.1	857	0.9	431	0.4	161	0.2
21	82,942	98.3	1,476	1.7	93	0.1	823	1.0	417	0.5	143	0.2
24	73,388	98.3	1,272	1.7	89	0.1	741	1.0	326	0.4	116	0.2
27	62,332	98.2	1,141	1.8	61	0.1	630	1.0	315	0.5	135	0.2
30	53,472	98.4	891	1.6	63	0.1	507	0.9	218	0.4	103	0.2
33	44,715	98.4	734	1.6	51	0.1	384	0.8	208	0.5	91	0.2
36	37,420	98.3	645	1.7	50	0.1	369	1.0	171	0.4	55	0.1
39	30,362	98.5	457	1.5	31	0.1	266	0.9	116	0.4	44	0.1
42	21,456	98.3	381	1.7	24	0.1	228	1.0	82	0.4	47	0.2
45	16,083	98.7	219	1.3	14	0.1	122	0.7	55	0.3	28	0.2
48	12,353	98.8	145	1.2	2	0.0	67	0.5	46	0.4	30	0.2

Note. Attrition is presented in 3-month intervals (e.g., Soldiers who separated between 1 day and 3 months post-accession all were counted as cases of 3-month attrition, whereas Soldiers who separated between 3 months plus 1 day and 6 months all were counted as cases of 6-month attrition).

Table 4. Cumulative Rates of Attrition Over Time

	Stayers		Overall		Performance		Misconduct		Medical/Physical		All Other Attrition	
Month	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
3	156,220	92.8	12,101	7.2	5,508	3.3	20	0.0	6,555	3.9	18	0.0
6	150,590	89.5	17,731	10.5	8,779	5.2	234	0.1	8,650	5.1	68	0.0
9	148,443	88.2	19,878	11.8	9,472	5.6	636	0.4	9,618	5.7	152	0.1
12	146,711	87.2	21,610	12.8	9,754	5.8	1,278	0.8	10,318	6.1	260	0.2
15	145,086	86.2	23,235	13.8	9,897	5.9	2,066	1.2	10,842	6.4	430	0.3
18	143,532	85.3	24,789	14.7	10,002	5.9	2,923	1.7	11,273	6.7	591	0.4
21	142,056	84.4	26,265	15.6	10,095	6.0	3,746	2.2	11,690	6.9	734	0.4
24	140,784	83.6	27,537	16.4	10,184	6.1	4,487	2.7	12,016	7.1	850	0.5
27	139,643	83.0	28,678	17.0	10,245	6.1	5,117	3.0	12,331	7.3	985	0.6
30	138,752	82.4	29,569	17.6	10,308	6.1	5,624	3.3	12,549	7.5	1,088	0.6
33	138,018	82.0	30,303	18.0	10,359	6.2	6,008	3.6	12,757	7.6	1,179	0.7
36	137,373	81.6	30,948	18.4	10,409	6.2	6,377	3.8	12,928	7.7	1,234	0.7
39	136,916	81.3	31,405	18.7	10,440	6.2	6,643	3.9	13,044	7.7	1,278	0.8
42	136,535	81.1	31,786	18.9	10,464	6.2	6,871	4.1	13,126	7.8	1,325	0.8
45	136,316	81.0	32,005	19.0	10,478	6.2	6,993	4.2	13,181	7.8	1,353	0.8
48	136,171	80.9	32,150	19.1	10,480	6.2	7,060	4.2	13,227	7.9	1,383	0.8

Figure 1 presents the trends of attrition rates over time. As shown in the figure, the rates for overall attrition as well as Performance- and Medical/Physical-related attrition quickly decline after 3 months and stabilize around 15 months. On the other hand, Misconduct-related attrition gradually increases before stabilizing at 21 months. Moreover, because of the low base rates of attrition due to performance, medical/physical, and all other reasons by around 12 months, the pattern of overall attrition largely reflects that of Misconduct-related attrition beginning around this time point.
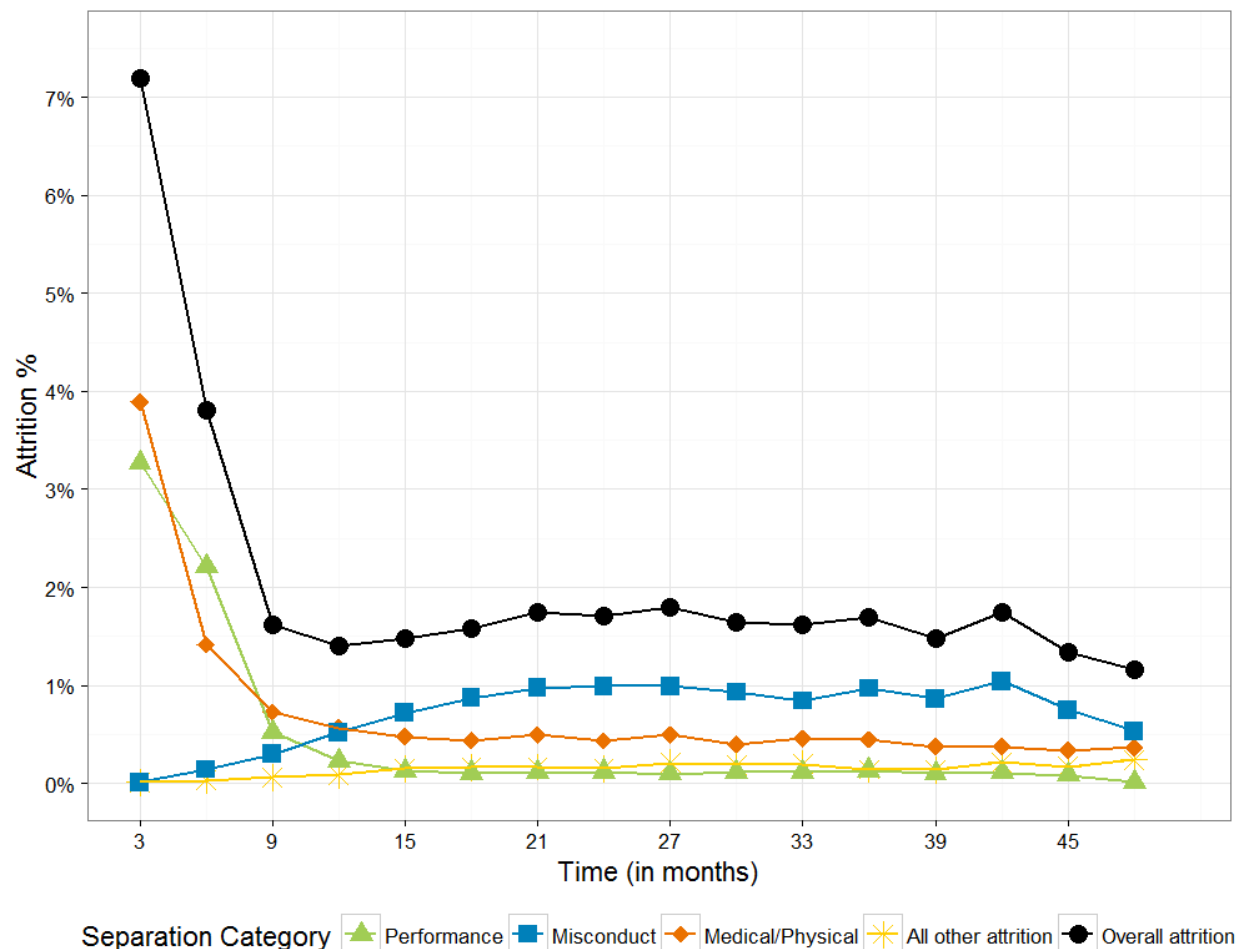
Figure 1. Attrition base rates over time.

Figure 2 presents the proportions of attrition by separation category over time. Between 3 and 9 months, Performance- and Medical/Physical-related attrition account for the majority (well over 50%) of all attrition. By 12 months, the rate of Performance-related attrition decreases sharply, while Medical/Physical-related attrition remains relatively high and Misconduct-related attrition increases sharply to account for nearly 40% of all attrition. From 15 months onward, Misconduct-related attrition accounts for the majority of all attrition, ranging from approximately 45% to 60% of attrition through 48 months. Although Medical/Physical-related attrition generally declines over the first 18 months, it continues to account for over 20% of all attrition through 48 months.
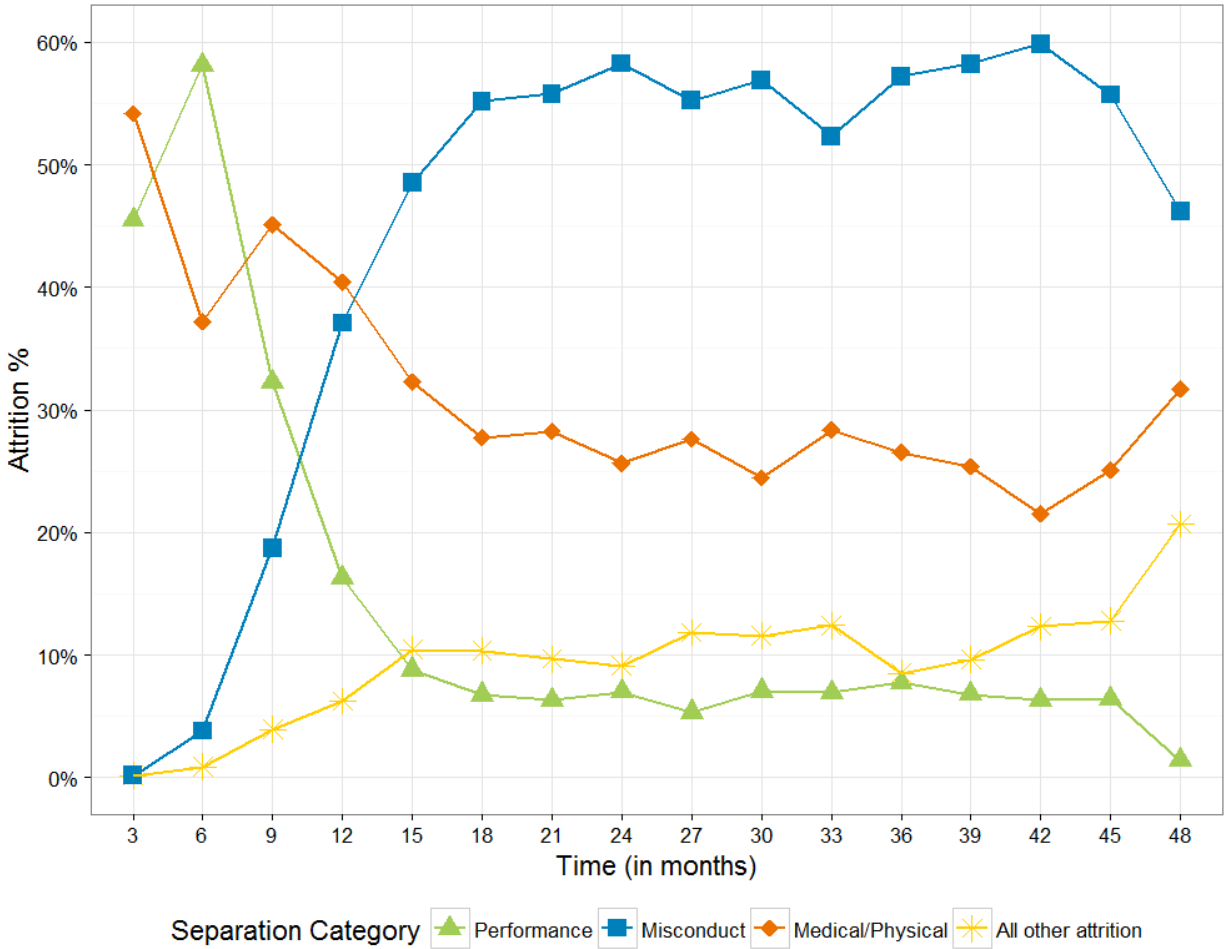
Figure 2. Proportion of attrition by separation category over time.

Question 2: What attributes predict attrition across Soldiers' first-term tenure within the Army?

Results of the final proportional hazards regression model for overall attrition are shown in Table 5. Note that the AFQT was included as the only predictor in Step 1. In Step 2, the main effects of the AFQT and TAPAS scales were included. Lastly, the time-varying effects (i.e., predictor interactions with time) were added during Step 3. Results are discussed with respect to the final Step 3 models.

With respect to the main effects, both the AFQT ($HR = 0.841$) and the Physical Conditioning TAPAS scale ($HR = 0.797$) had strong negative relationships with attrition over time, indicating that the probability of attrition declines among those with higher scores on the AFQT and the Physical Conditioning TAPAS scale. Conversely, Selflessness ($HR = 1.091$) and Intellectual Efficiency ($HR = 1.083$) were positively related to attrition over time, suggesting that the probability of separating increases among individuals who score higher on these scales. Importantly, the effects of the AFQT, Achievement, Adjustment, Physical Conditioning, Selflessness, and Sociability all had significant interactions with time. As such, it is important to

examine the nature of the interactions to understand the specific relationships these predictors have with attrition over time.

Table 5. Final Proportional Hazards Regression Results for Overall Attrition

Model Fit				Step 3 Predictor Statistics				
Model	*df*	-2LL	Δ-2LL	Predictor	β	*HR*	*HR* 95% LL	*HR* 95% UL
Step 1	1	365405.94	—	AFQT	**-0.173**	0.841	0.820	0.862
Step 2	11	364785.55	**620.39**	Achievement	-0.012	0.988	0.964	1.014
Step 3	17	364671.91	**113.64**	Adjustment	-0.002	0.998	0.974	1.024
				Dominance	**-0.024**	0.976	0.959	0.993
				Even-tempered	**-0.041**	0.960	0.944	0.976
				Intellectual Efficiency	**0.080**	1.083	1.064	1.103
				Optimism	**-0.031**	0.970	0.953	0.986
				Physical Conditioning	**-0.227**	0.797	0.778	0.817
				Self-Control	**-0.021**	0.979	0.963	0.996
				Selflessness	**0.088**	1.091	1.065	1.118
				Sociability	0.022	1.022	0.997	1.048
				Time x AFQT	**-0.003**	0.997	0.996	0.999
				Time x Achievement	**-0.002**	0.998	0.997	0.999
				Time x Adjustment	**0.002**	1.002	1.001	1.003
				Time x Physical Conditioning	**0.005**	1.005	1.003	1.006
				Time x Selflessness	**-0.002**	0.998	0.997	0.999
				Time x Sociability	**0.002**	1.002	1.001	1.003

Note. n = 72,009. -2LL = -2 log likelihood. β = standardized parameter. *HR* = Hazard ratio. 95% LL = 95% confidence interval lower limit of the hazard ratio. 95% UL = 95% confidence interval upper limit of the hazard ratio. The Step 1 model includes the AFQT only. The Step 2 model adds the TAPAS scale main effects to the Step 1 model. The Step 3 model adds the interaction terms (i.e., time-varying effects) to the Step 2 model. All models are significant, $p < .05$. The Step 2 and 3 models resulted in significant change in model fit compared to the previous steps based on a Likelihood Ratio χ2 test, $p < .05$. Bolded values indicate significant predictor effects, $p < .05$.

Figure 3 plots the time-varying effects in terms of *HR*s at 6-month intervals over time. The vertical lines extending above and below each *HR* correspond to the 95% CI around the estimate. Gray points denote *HR*s where the 95% CI overlaps with 1.00, whereas red points denote *HR*s where the 95% CI does not overlap with 1.00. For the AFQT and Achievement, the strength of their relationships with attrition becomes more negative over time. On the other hand, the relationships with attrition for Adjustment and Sociability become increasingly positive over time. Finally, the relationships with attrition for both the Physical Conditioning and Selflessness TAPAS scales decrease in magnitude, with the effect of each becoming negligible by 48 months.
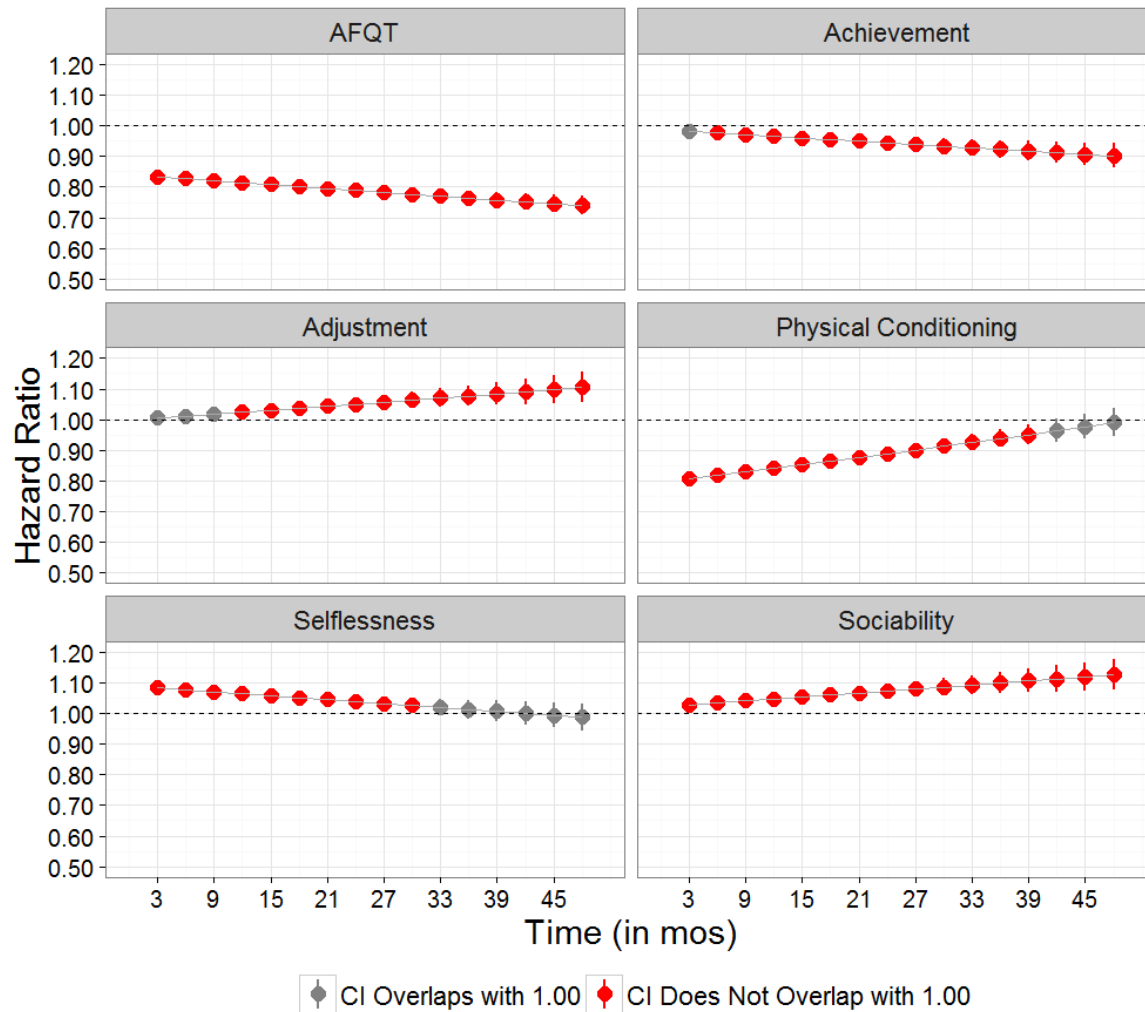
Figure 3. Time-varying effects from the proportional hazards regression model of overall attrition.

Tables 6 through 8 present the results of the final proportional hazards regression models for attrition due to performance, misconduct, and medical/physical reasons, respectively. Like the model for overall attrition, the inclusion of the time-varying effects resulted in significant improvement in fit beyond the main effects-only model for each separation category.

As shown in Table 6, the AFQT ($HR = 0.825$) and Physical Conditioning ($HR = 0.790$) were the strongest predictors of Performance-related attrition, and each exhibited negative relationships. Conversely, Intellectual Efficiency ($HR = 1.070$) had the strongest positive relationship with Performance-related attrition over time. Additionally, only the effect of Achievement demonstrated an interaction with time on Performance-related attrition. Figure 4 presents this time-varying effect, showing that the relationship between Achievement and Performance-related attrition becomes increasingly negative through 48 months ($HR_{48 \text{ mos}} = 0.758$).

Table 6. Final Proportional Hazards Regression Results for Performance-related Attrition

Model	df	-2LL	Δ-2LL	Predictor	β	HR	HR 95% LL	HR 95% UL
		Model Fit			Step 3 Predictor Statistics			
Step 1	1	152778.28	—	AFQT	**-0.192**	0.825	0.804	0.847
Step 2	8	152240.07	**538.21**	Achievement	**-0.044**	0.957	0.924	0.992
Step 3	9	152232.98	**7.09**	Adjustment	**0.031**	1.032	1.005	1.059
				Attention Seeking	**-0.080**	0.924	0.901	0.947
				Intellectual Efficiency	**0.068**	1.070	1.041	1.100
				Optimism	**-0.054**	0.947	0.923	0.972
				Physical Conditioning	**-0.236**	0.790	0.770	0.810
				Selflessness	**0.051**	1.052	1.026	1.079
				Time x Achievement	**-0.005**	0.995	0.992	0.999

Note. n = 104,024. -2LL = -2 log likelihood. β = standardized parameter. *HR* = Hazard ratio. 95% LL = 95% confidence interval lower limit of the hazard ratio. 95% UL = 95% confidence interval upper limit of the hazard ratio. The Step 1 model includes the AFQT only. The Step 2 model adds the TAPAS scale main effects to the Step 1 model. The Step 3 model adds the interaction terms (i.e., time-varying effects) to the Step 2 model. All models are significant, $p < .05$. The Step 2 and Step 3 models resulted in significant changes in model fit compared to the previous steps based on a Likelihood Ratio χ2 test, $p < .05$. Bolded values indicate significant predictor effects, $p < .05$.
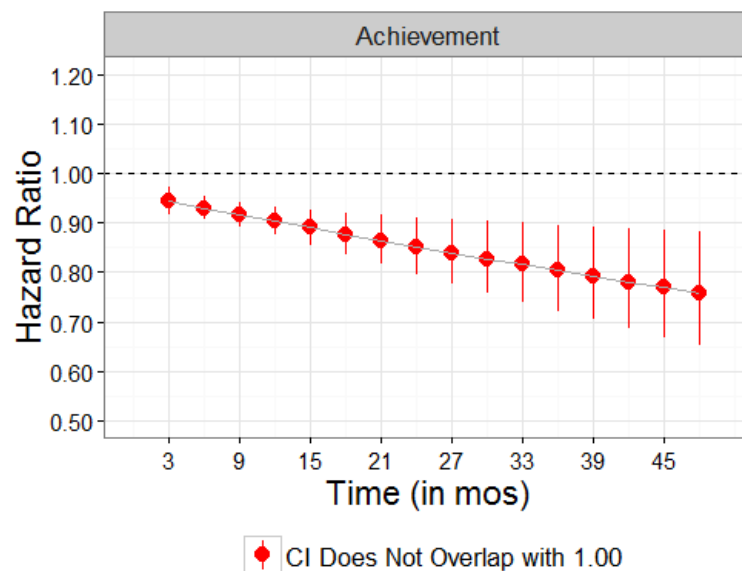
Figure 4. Time-varying effects from the proportional hazards regression model of Performance-related attrition.

Regarding Misconduct-related attrition, Table 7 shows that the AFQT (*HR* = 0.769) and Non-delinquency (*HR* = 0.867) were the strongest predictors, and both exhibited negative effects. The strongest positive relationships with Misconduct-related attrition were evidenced by Intellectual Efficiency (*HR* = 1.143) and Attention Seeking (*HR* = 1.128). In addition, the time-varying effects of the AFQT and Even-tempered scale were significant. As shown in Figure 5, the

negative relationship between the AFQT ($HR_{48\text{ mos}} = 0.616$) and Misconduct-related attrition became increasingly negative over time. Even-tempered was unrelated to Misconduct-related attrition until 24 months, at which time it evidenced a negative relationship.

Table 7. *Final Proportional Hazards Regression Results for Misconduct-related Attrition*

		Model Fit		Step 3 Predictor Statistics				
Model	*df*	-2LL	Δ-2LL	Predictor	β	*HR*	*HR* 95% LL	*HR* 95% UL
Step 1	1	118698.07	—	AFQT	**-0.263**	0.769	0.717	0.825
Step 2	11	118119.08	**578.99**	Achievement	**-0.082**	0.921	0.894	0.950
Step 3	13	118101.62	**17.46**	Adjustment	**0.101**	1.107	1.076	1.139
				Attention Seeking	**0.120**	1.128	1.095	1.162
				Dominance	**0.054**	1.055	1.023	1.088
				Even-tempered	0.034	1.035	0.964	1.111
				Intellectual Efficiency	**0.134**	1.143	1.107	1.180
				Non-Delinquency	**-0.143**	0.867	0.842	0.892
				Physical Conditioning	**0.043**	1.044	1.014	1.074
				Sociability	**0.080**	1.083	1.052	1.116
				Tolerance	**-0.070**	0.932	0.906	0.959
				Time x AFQT	**-0.005**	0.995	0.993	0.998
				Time x Even-tempered	**-0.003**	0.997	0.994	1.000

Note. n = 104,129. -2LL = -2 log likelihood. β = standardized parameter. *HR* = Hazard ratio. 95% LL = 95% confidence interval lower limit of the hazard ratio. 95% UL = 95% confidence interval upper limit of the hazard ratio. The Step 1 model includes the AFQT only. The Step 2 model adds the TAPAS scale main effects to the Step 1 model. The Step 3 model adds the interaction terms (i.e., time-varying effects) to the Step 2 model. All models are significant, *p* < .05. The Step 2 and 3 models resulted in significant change in model fit compared to the previous steps based on a Likelihood Ratio χ2 test, *p* < .05. Bolded values indicate significant predictor effects, *p* < .05.
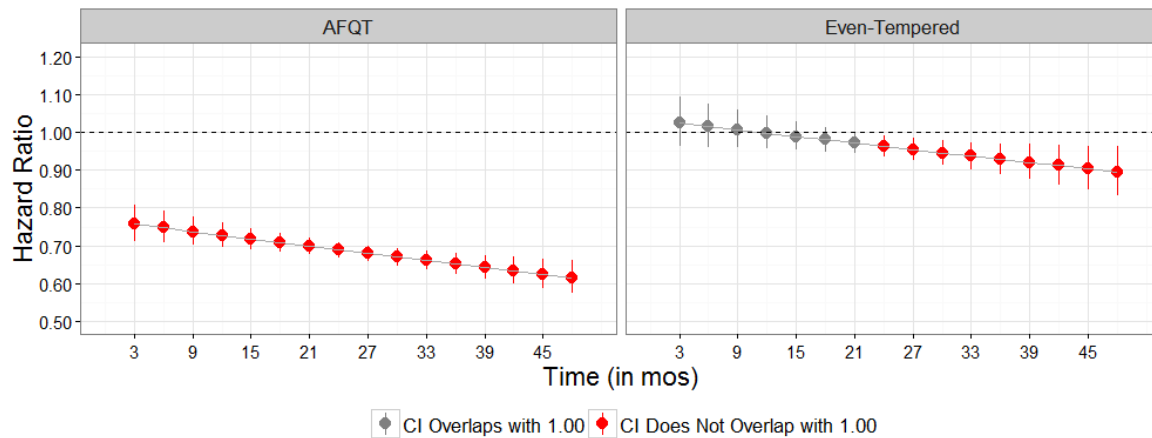

Figure 5. Time-varying effects from the proportional hazards regression model of Misconduct-related attrition.

Table 8 presents the final proportional hazards regression model for Medical/Physical-related attrition. Similar to Performance-related attrition, the AFQT (*HR* = 0.846) and the Physical Conditioning TAPAS scale (*HR* = 0.804) had the strongest negative relationships with Medical/Physical-related attrition over time, with the effect of the AFQT also demonstrating a significant interaction with time. Selflessness (*HR* = 1.126) had the strongest positive relationship with Medical/Physical-related attrition and also exhibited a significant interaction with time.

Table 8. Final Proportional Hazards Regression Results for Medical/Physical-related Attrition

Model Fit				Step 3 Predictor Statistics				
Model	*df*	-2LL	Δ-2LL	Predictor	β	HR	*HR* 95% LL	*HR* 95% UL
Step 1	1	142159.82	—	AFQT	**-0.167**	0.846	0.816	0.878
Step 2	11	141650.35	**509.47**	Attention Seeking	**-0.048**	0.953	0.927	0.979
Step 3	15	141609.43	**40.92**	Dominance	-0.036	0.965	0.929	1.001
				Even-tempered	**-0.071**	0.932	0.897	0.967
				Intellectual Efficiency	**0.063**	1.065	1.035	1.096
				Non-Delinquency	**0.071**	1.073	1.045	1.102
				Optimism	**-0.053**	0.949	0.924	0.974
				Physical Conditioning	**-0.219**	0.804	0.783	0.825
				Self-Control	**-0.037**	0.964	0.938	0.990
				Selflessness	**0.118**	1.126	1.085	1.167
				Sociability	**0.059**	1.061	1.032	1.090
				Time x AFQT	**0.004**	1.004	1.002	1.006
				Time x Dominance	**-0.004**	0.996	0.994	0.999
				Time x Even-tempered	**0.003**	1.003	1.001	1.006
				Time x Selflessness	**-0.002**	0.998	0.995	1.000

Note. *n* = 72,009. -2LL = -2 log likelihood. β = standardized parameter. *HR* = Hazard ratio. 95% LL = 95% confidence interval lower limit of the hazard ratio. 95% UL = 95% confidence interval upper limit of the hazard ratio. The Step 1 model includes the AFQT only. The Step 2 model adds the TAPAS scale main effects to the Step 1 model. The Step 3 model adds the interaction terms (i.e., time-varying effects) to the Step 2 model. All models are significant, *p* < .05. The Step 2 and 3 models resulted in significant change in model fit compared to the previous steps based on a Likelihood Ratio χ2 test, *p* < .05. Bolded values indicate significant predictor effects, *p* < .05.

Figure 6 displays the time-varying effects of the AFQT and Selflessness, as well as Dominance and Even-tempered. The magnitude of the effects of both the AFQT and Selflessness on Medical/Physical-related attrition decreases over time, with neither predictor exhibiting an effect at 33 months or later. The negative effect of Dominance on Medical/Physical-related attrition becomes increasingly negative over time ($HR_{48\ mos}$ = 0.815). Finally, the initially *negative* effect of Even-tempered on Medical/Physical-related attrition decreases through 12 months before becoming increasingly *positive* from 42 to 48 months ($HR_{48\ mos}$ = 1.102).

Question 3: What attributes predict attrition at critical junctures in Soldier tenure?

Results of the logistic regression analyses are presented in Tables 9 through 11 for Performance-, Misconduct-, and Medical/Physical-related attrition, respectively. For each separation category,

the final logistic regression model is presented for attrition at four periods of time post-accession. With the exception of predicting Misconduct-related attrition between 0 and 6 months, the inclusion of the TAPAS scales to the AFQT-only model resulted in significantly better fit. Therefore, the results of the logistic regression analyses are discussed for the combined AFQT and TAPAS models.
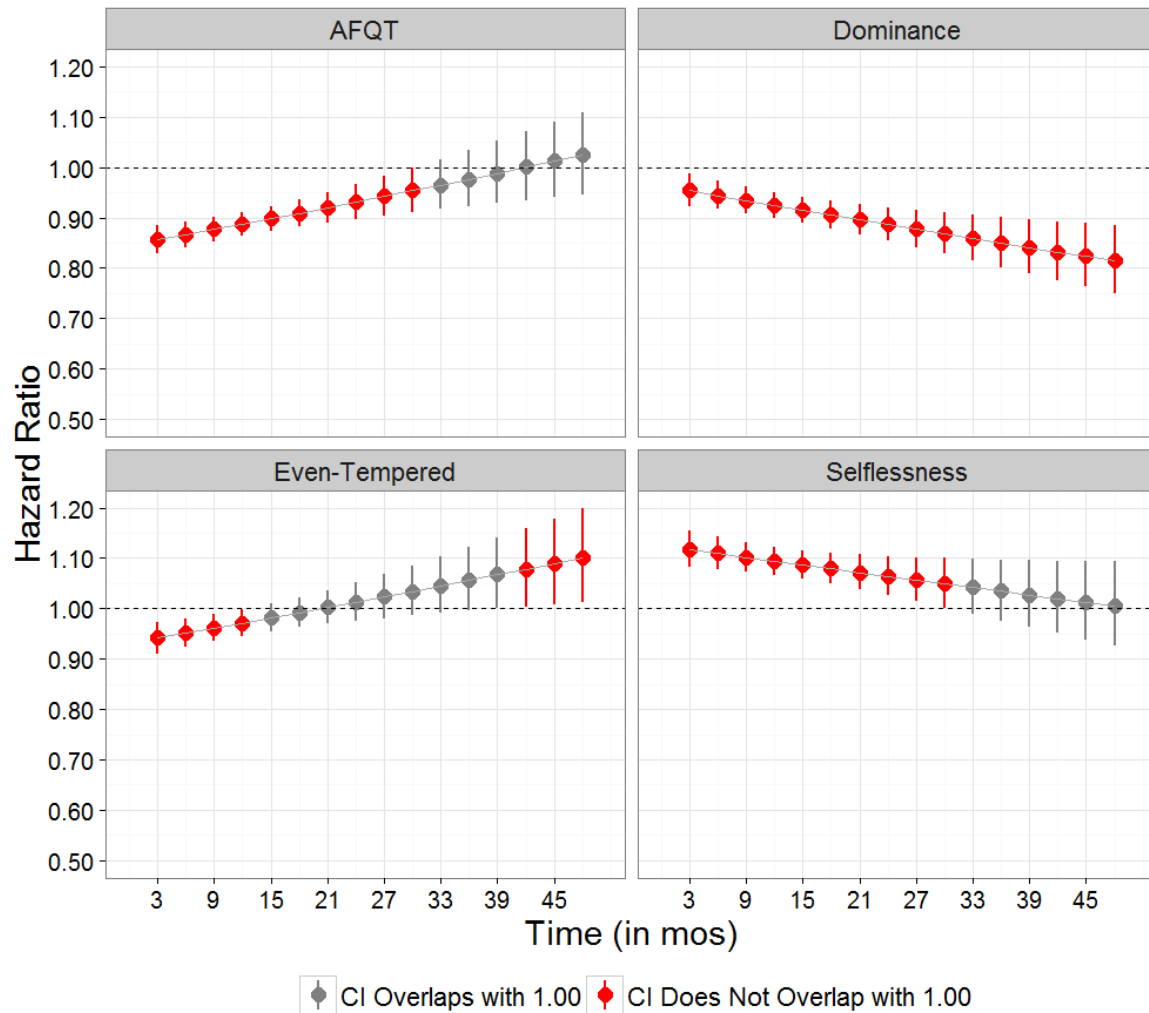
Figure 6. Time-varying effects from the proportional hazards regression model of Medical/Physical-related attrition.

With respect to Performance-related attrition, Table 9 shows that the AFQT is negatively related to attrition ($ORs \leq 0.876$) except after 12 through 24 months. The Physical Conditioning TAPAS scale is negatively related to Performance-related attrition at all four time points ($ORs \leq 0.775$). In addition, Achievement ($ORs \leq 0.934$) and Attention Seeking ($ORs \leq 0.947$) have negative relationships at both the 0-6- and greater than 6-month time periods. Even-tempered is negatively related ($OR = 0.960$) to Performance-related attrition at the 0-6-month time period but positively related ($OR = 1.153$) related at the greater than 12-month time period.

Table 9. Final Logistic Regression Results for Performance-related Attrition

Time Period (in mos)	Model Fit				Step 2 Predictor Statistics			
	Model	df	-2LL	Δ-2LL	Predictor	OR	OR 95% LL	OR 95% UL
0-6	Step 1	1	**27669.66**		AFQT	0.784	0.759	0.811
	Step 2	9	**27369.55**	**300.11**	AFQT	0.771	0.743	0.799
					Achievement	0.934	0.901	0.968
					Adjustment	1.058	1.020	1.098
					Attention Seeking	0.947	0.914	0.981
					Even-tempered	0.960	0.926	0.995
					Intellectual Efficiency	1.088	1.047	1.131
					Optimism	0.947	0.913	0.983
					Physical Conditioning	0.775	0.748	0.803
					Selflessness	1.069	1.033	1.107
>6-12	Step 1	1	**5186.55**		AFQT	0.876	0.800	0.960
	Step 2	4	**5111.53**	**75.03**	AFQT	0.893	0.815	0.978
					Achievement	0.884	0.804	0.973
					Attention Seeking	0.875	0.795	0.964
					Physical Conditioning	0.705	0.639	0.778
>12-24	Step 1	1	3042.70		AFQT	*ns*	0.810	1.033
	Step 2	3	**3003.74**	—[a]	Achievement	0.846	0.745	0.962
					Even-tempered	1.153	1.013	1.313
					Physical Conditioning	0.721	0.632	0.822
>24-36	Step 1	1	**2261.77**		AFQT	0.690	0.597	0.798
	Step 2	5	**2232.57**	**29.20**	AFQT	0.699	0.605	0.808
					Achievement	0.842	0.723	0.982
					Physical Conditioning	0.766	0.657	0.892
					Self-Control	0.852	0.731	0.992
					Tolerance	1.197	1.030	1.391

Note. -2LL = -2 log likelihood (deviance). *OR* = odds ratio. 95% LL = 95% confidence interval lower limit of the odds ratio. 95% UL = 95% confidence interval upper limit of the odds ratio. The Step 1 model includes the AFQT only. The Step 2 model adds the TAPAS scales to the AFQT-only model. All predictors are significant ($p < .05$) unless otherwise noted. Bolded values indicate either significant model fit (-2LL) or significant change in model fit (Δ-2LL) based on a Likelihood Ratio χ2 test, $p < .05$.
[a] The effect of AFQT was not significant so it was removed from the final model. As a result, the AFQT-only and Final models are not nested and the change in fit cannot be computed.

Table 10 presents the results for Misconduct-related attrition, and shows that the AFQT has negative relationships at all four time periods in the final models (*OR*s ≤ 0.779). Non-delinquency (*OR*s ≤ 0.883) and Achievement (*OR*s ≤ 0.931) also exhibit negative relationships with Misconduct-related attrition at the greater than 6-, greater than 12-, and greater than 24-month time periods. On the other hand, Intellectual Efficiency (*OR*s ≥ 1.114) and Sociability (*OR*s ≥ 1.089) have the most consistently strong, positive relationships with Misconduct-related attrition, with significant effects at the greater than 6-, greater than 12-, and greater than 24-month time periods. Only the AFQT exhibited a

significant effect on Misconduct-related attrition at the 0-6-month time period. However, the base rates of Misconduct-related attrition at 3 and 6 months are near 0.

Table 10. Final Logistic Regression Results for Misconduct-related Attrition

Time Period (in mos)	Model Fit				Step 2 Predictor Statistics			
	Model	df	-2LL	Δ-2LL	Predictor	OR	OR 95% LL	OR 95% UL
0-6 [a]	Step 1	1	**1812.98**		AFQT	0.710	0.597	0.844
>6-12	Step 1	1	**5880.75**		AFQT	0.816	0.749	0.890
	Step 2	6	**5811.42**	**69.32**	AFQT	0.779	0.708	0.856
					Achievement	0.902	0.822	0.990
					Attention Seeking	1.139	1.035	1.254
					Intellectual Efficiency	1.163	1.051	1.286
					Non-Delinquency	0.847	0.773	0.929
					Sociability	1.227	1.115	1.350
>12-24	Step 1	1	**15663.04**		AFQT	0.723	0.690	0.758
	Step 2	9	**15468.37**	**194.67**	AFQT	0.679	0.645	0.715
					Achievement	0.931	0.884	0.982
					Adjustment	1.103	1.050	1.158
					Attention Seeking	1.166	1.107	1.228
					Dominance	1.092	1.035	1.152
					Intellectual Efficiency	1.114	1.053	1.178
					Non-Delinquency	0.883	0.841	0.927
					Sociability	1.097	1.041	1.157
					Tolerance	0.935	0.891	0.982
>24-36	Step 1	1	**12120.78**		AFQT	0.677	0.643	0.714
	Step 2	7	**11920.17**	**200.61**	AFQT	0.617	0.582	0.654
					Achievement	0.916	0.865	0.969
					Adjustment	1.087	1.029	1.148
					Attention Seeking	1.154	1.088	1.223
					Intellectual Efficiency	1.215	1.142	1.292
					Non-Delinquency	0.796	0.754	0.841
					Sociability	1.089	1.028	1.153

Note. -2LL = -2 log likelihood (deviance). *OR* = odds ratio. 95% LL = 95% confidence interval lower limit of the odds ratio. 95% UL = 95% confidence interval upper limit of the odds ratio. The Step 1 model includes the AFQT only. The Step 2 model adds the TAPAS scales to the AFQT-only model. All predictors are significant, $p < .05$. Bolded values indicate either significant model fit (-2LL) or significant change in model fit (Δ-2LL) based on a Likelihood Ratio $\chi 2$ test, $p < .05$.

[a] None of the TAPAS scale effects were significant so they were not included in the final model. Thus, only the Step 1 AFQT-only model was fitted.

Finally, Table 11 presents the results of the logistic regression models for Medical/Physical-related attrition. With the exception of the greater than 6-month time period, the AFQT is negatively related to Medical/Physical-related attrition (*OR*s ≤ 0.924). The Physical Conditioning

TAPAS scale has a strong negative relationship with Medical-related attrition at all four time points ($ORs \leq 0.802$). Also of note, Dominance has a negative relationship at the 0-6-, greater than 6-, and greater than 12-month time periods ($ORs \leq 0.960$). Regarding positive relationships with Medical/Physical-related attrition, Non-delinquency ($ORs \geq 1.062$) is positively related at the 0-6- and greater than 6-month time periods, and Selflessness ($ORs \geq 1.106$) is positively related at the 0-6- and greater than 12-month time periods.

Table 11. Final Logistic Regression Results for Medical/Physical-related Attrition

Time Period (in mos)	Model	*df*	-2LL	Δ-2LL	Predictor	OR	OR 95% LL	OR 95% UL
			Model Fit		Step 2 Predictor Statistics			
0-6	Step 1	1	**27135.09**		AFQT	0.789	0.763	0.816
	Step 2	10	**26855.36**	**279.73**	AFQT	0.794	0.765	0.824
					Attention Seeking	0.925	0.890	0.960
					Dominance	0.960	0.924	0.997
					Even-tempered	0.931	0.897	0.966
					Intellectual Efficiency	1.083	1.041	1.126
					Non-Delinquency	1.062	1.024	1.101
					Optimism	0.958	0.924	0.994
					Physical Conditioning	0.802	0.774	0.831
					Selflessness	1.118	1.079	1.158
					Sociability	1.086	1.045	1.128
>6-12	Step 1	1	8810.95		AFQT	*ns*	0.976	1.112
	Step 2	3	**8709.95**	—[a]	Dominance	0.889	0.829	0.953
					Non-Delinquency	1.085	1.012	1.164
					Physical Conditioning	0.737	0.687	0.791
>12-24	Step 1	1	**9785.52**		AFQT	0.910	0.857	0.967
	Step 2	5	**9687.17**	**98.35**	AFQT	0.924	0.870	0.982
					Dominance	0.889	0.833	0.948
					Physical Conditioning	0.788	0.738	0.841
					Selflessness	1.106	1.035	1.183
					Tolerance	1.087	1.017	1.163
>24-36	Step 1	1	**7000.81**		AFQT	0.826	0.769	0.887
	Step 2	4	**6935.07**	**65.74**	AFQT	0.814	0.757	0.875
					Optimism	0.918	0.850	0.991
					Order	0.899	0.833	0.970
					Physical Conditioning	0.763	0.707	0.824

Note. -2LL = -2 log likelihood (deviance). *OR* = odds ratio. 95% LL = 95% confidence interval lower limit of the odds ratio. 95% UL = 95% confidence interval upper limit of the odds ratio. The Step 1 model includes the AFQT only. The Step 2 model adds the TAPAS scales to the AFQT-only model. All predictors are significant ($p < .05$) unless otherwise noted. Bolded values indicate either significant model fit (-2LL) or significant change in model fit (Δ-2LL) based on a Likelihood Ratio χ2 test, $p < .05$.

[a] The effect of AFQT was not significant so it was removed from the final model. As a result, the AFQT-only and Final models are not nested and the change in fit cannot be computed.

Conclusion

The present research sought to examine the nature of Soldier attrition in a longitudinal context, both overall as well as with regard to three specific types of attrition of particular interest to the Army: Performance, Misconduct, and Medical/Physical. Specifically, we used descriptive analyses to examine rates of attrition as Soldiers progress through their first terms of service. In addition, we used regression methods to identify cognitive and noncognitive attributes that predict attrition over time as well as at key time periods of interest.

Comparisons of base rates over time for the three types of attrition revealed marked differences in the incidence and rate of attrition, depending on both the reasons for separation as well as Soldiers' length of service. Performance- and Medical/Physical-related attrition are far more likely within the first few months following accession into the Army than they are later in a Soldier's enlistment term. In fact, at both 3 and 6 months, nearly all attrition is due to one of these two reasons. However, at 9 months, less than 1% of Soldiers separate from the Army due to either performance or medical/physical issues. Conversely, Misconduct-related attrition is more likely later during a Soldier's term of service (and is the most common reason for separation between 15 and 48 months) and rarely occurs within the first 6 months of service.

Results from the Cox proportional hazards models revealed that the AFQT is a strong cognitive predictor of attrition in terms of overall rates and specific separation types. For Misconduct-related attrition in particular, the effect of AFQT increased over time. At 6 months post-accession, the relative risk of Misconduct-related attrition decreased approximately 23% for every standard deviation increase in AFQT scores.[4] By 48 months, the relative risk of Misconduct-related attrition associated with the AFQT decreased approximately 38%. For Medical/Physical-related attrition, however, the negative effect of the AFQT decreased over time and became negligible by 33 months. It is important to note that some caution is warranted when interpreting the time-varying effects revealed by the present analyses. Although the results reflect linear changes in some of the effects over time, it is possible that some of these trends are in fact non-linear. Additional research would need to empirically model alternative time-varying trends (e.g., quadratic, logarithmic) before drawing strong conclusions regarding the time-specific effects associated with the predictors studied here.

Notably, the Physical Conditioning TAPAS scale was an even stronger predictor of attrition for Performance- and Medical/Physical-related attrition than was the AFQT. For attrition due to Medical/Physical reasons, the relative risk decreased approximately 20% for each standard deviation increase in Physical Conditioning TAPAS scale scores. For Performance-related attrition, the effect was similar, with a decrease in the relative risk of approximately 21% for each standard deviation increase in scores. Given the intensive physical requirements associated with many Army occupations, it is not surprising that Physical Conditioning is so strongly linked to Performance-related attrition. In addition, the uniformly high physical demands imposed by basic training regardless of MOS also likely contribute to the strong effect due to Physical

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[4] To facilitate the discussion of results, we express the *HR* associated with a given predictor in terms of percent-change of attrition. Percent-change in a hazard is equal to $100*(HR – 1)$ (Singer & Willett, 2003, p. 527).

Conditioning early in Soldiers' careers. Similarly, it is expected that one's physical health should be associated with medical- or physical-related outcomes (McHenry et al., 1990).

With respect to Misconduct-related attrition, the strongest non-cognitive predictor was Non-delinquency, which was associated with an approximate 13% decrease in the hazard of attrition for each standard deviation increase in scores. This relationship is intuitive given that deviant individuals should be more likely to engage in CPWB or otherwise inappropriate behavior (Gruys & Sackett, 2003; Robinson & Bennett, 1995). On the other hand, a number of TAPAS scales were positively linked to Misconduct-related attrition including Intellectual Efficiency, Attention Seeking, and Adjustment. For these TAPAS scales, the relative risk of attrition increased 10% or more for each standard deviation increase in scores. Given the non-negligible effects of these latter characteristics, additional research should investigate the particular nature of these relationships. However, significant bivariate correlations between Intellectual Efficiency and attrition (overall and specific types) were negative, and Intellectual Efficiency generally exhibits moderate positive correlations with the AFQT (Knapp & LaPort, 2014). Thus, it is possible that the positive relationships between Intellectual Efficiency and attrition are due to suppressor effects (see Darlington, 1968). In any case, additional research should seek to gain a better understanding of the effects of Intellectual Efficiency and attrition.

Results of the logistic regression analyses provided complementary findings to the proportional hazards regression analyses. At all time periods, the negative relationships of Physical Conditioning with both Performance- and Medical/Physical-related attrition was nearly as strong as, if not stronger than, those exhibited by the AFQT. For Misconduct-related attrition, the AFQT was the strongest predictor, although Non-delinquency also exhibited a negative relationship at three of the four time periods.

Taken together, the results of both the descriptive and regression analyses suggest that predicting attrition depends critically on both the type of attrition one wishes to predict and the approximate time of interest in a Soldier's career. For instance, the AFQT related negatively related to the three types of attrition, but its effect changed over time for both Misconduct- and Medical/Physical-related attrition. Additionally, the most important non-cognitive predictors varied by separation category, with the Physical Conditioning TAPAS scale appearing as the most important predictor of Performance- and Medical/Physical-related attrition and Non-delinquency the most important for Misconduct-related attrition. Because base rates of attrition differ markedly depending on Soldiers' time in service, investigations into the meaningful predictors of attrition at *specific points in time* may be an effective strategy at reducing attrition when Soldiers are at greatest risk for attrition. Moreover, understanding these differential patterns of attrition over time may be useful in identifying corresponding key events or milestones during Soldiers' careers that may contribute to the incidence of attrition.

A few limitations surrounding the present research should be noted. For instance, the sample used for all analyses included Soldiers who accessed between 2005 and 2014. Rates and incidence of attrition could differ across specific cohorts within this sample as well as future cohorts. However, previous research among Soldiers from the 1999 through 2002 accession cohort found similar patterns of attrition rates, including patterns of Performance, Misconduct,

and Medical/Physical attrition (Strickland, 2005).[5] Similarly, it is possible that the observed relationships between attrition and both the AFQT and TAPAS scales could change across cohorts due to unobserved "third" variables (e.g., wars or other military involvement in foreign countries). The present analyses also did not account for Soldier deployment. Because Soldiers may be less likely or otherwise unable to separate from the Army while deployed, the effects of both cognitive and noncognitive predictors of attrition may differ across Soldiers who are and are not deployed. These issues represent a few ways in which future research could further seek to increase our understanding of attrition and the variables associated with it.

In all, these findings suggest that predicting attrition is a complex issue. Although certain attributes may clearly emerge as important for predicting one type of attrition, those same attributes may be altogether unrelated to other types of attrition. Further, those attributes that predict one type of attrition well at a given time might not do so well at other points in time. Practically, the costs and implications of attrition for the Army may also differ depending on the reasons. For instance, Soldier misconduct could entail costly disciplinary actions prior to separation, and the amount of lost investments is greater for Soldiers who separate later in their terms of service. Given the importance of attrition types, future research might aim to identify other motivational or performance-related attributes associated with attrition. Operationally, such data could be used to identify high-risk Soldiers at different points in their careers and employ interventions to alleviate said risks. Nonetheless, this research provides a detailed look at attrition over time and the factors most strongly related to its occurrence.

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[5] The types of attrition examined by Strickland (2005) and in the present research reflect some differences with respect to the component ISCs due to revisions made to those codes over time. However, the specific ISCs that comprise Medical/Physical and Performance attrition are very similar across studies. Additionally, Moral Character attrition as examined by Strickland (2005) is very similar to Misconduct attrition with respect to the component ISCs.

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Appendix A

TAPAS Scales Included in the Present Research

TAPAS Scale	Description
Achievement	High scoring individuals are seen as hard working, ambitious, confident, and resourceful.
Adjustment	High scoring individuals are worry free, and handle stress well; low scoring individuals are generally high strung, self-conscious and apprehensive.
Attention Seeking	High scoring individuals tend to engage in behaviors that attract social attention; they are loud, loquacious, entertaining, and even boastful.
Cooperation	High scoring individuals are trusting, cordial, non-critical, and easy to get along with.
Dominance	High scoring individuals are domineering, "take charge" and are often referred to by their peers as "natural leaders."
Even-tempered	High scoring individuals tend to be calm and stable. They don't often exhibit anger, hostility, or aggression.
Intellectual Efficiency	High scoring individuals are able to process information quickly and would be described by others as knowledgeable, astute, and intellectual.
Non-Delinquency	High scoring individuals tend to comply with rules, customs, norms, and expectations, and they tend not to challenge authority.
Optimism	High scoring individuals have a positive outlook on life and tend to experience joy and a sense of well-being.
Order	High scoring individuals tend to organize tasks and activities and desire to maintain neat and clean surroundings.
Physical Conditioning	High scoring individuals tend to engage in activities to maintain their physical fitness and are more likely to participate in vigorous sports or exercise.
Self-Control	High scoring individuals tend to be cautious, levelheaded, able to delay gratification, and patient.
Selflessness	High scoring individuals are generous with their time and resources.
Sociability	High scoring individuals tend to seek out and initiate social interactions.
Tolerance	High scoring individuals scoring are interested in other cultures and opinions that may differ from their own. They are willing to adapt to novel environments and situations.

Note. TAPAS scale descriptions are borrowed with permission from Drasgow, Stark, Chernyshenko, Nye, Hulin, and White (2012).